NEXRAD Product Improvement
Open Radar Data Acquisition (ORDA)
Systems Engineering Management Plan (SEMP)

NWS Office of Science and Technology

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DRAFT
Open Radar Data Acquisition
Systems Engineering Management Plan

NEXRAD Systems Engineering Management Plan (SEMP)

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1 Scope

This SEMP focuses on the Open Radar Data Acquisition (ORDA) deve lopment phase of the NPI Program, which is ongoing and will continue through full fielding and post-deployment evolution of the ORDA system. It introduces the NEXRAD Product Improvement (NPI) Program, the ORDA project, and its purpose

1.1 Introduction to the NEXRAD Product Improvement Program

This section introduces the NPI Program, including its background and historical context, and the sequence of development activities.

The NPI Program is a continuing effort to replace the WSR-88D Radar Data Acquisition (RDA), Radar Product Generation (RPG), and Principal User Processor (PUP) subsystems with open systems components. NEXRAD refers to the WSR-88D Doppler meteorological radar network currently under deployment throughout the world. The NEXRAD agencies supporting this effort are the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce, the Federal Aviation Administration (FAA) of the U.S. Department of Transportation, and the Air Force Weather Agency (AFWA) of the United States Air Force, Department of Defense (USAF DOD).

To create an orderly WSR-88D system evolution, the NEXRAD tri-agencies established the NPI Program as a long-term program to plan, manage, and execute major improvements to the WSR-88D system. The NPI Program will enable continuous evolution of the WSR-88D system to meet changing user needs, thereby avoiding the gradual obsolescence of the WSR-88D system and the associated costs of a major system acquisition.

The first phase of the NPI Program is to transition the WSR-88D to an infrastructure that facilitates the infusion of new technology that meets the Government Performance and Results Act (GPRA) goals, and improves system maintainability and availability. . The transition started with the coordination and pre-production efforts on the open system Radar Product Generator (ORPG) in FY 1996 and ends with the deployment of the last open system Radar Data Acquisition Status and Control/Signal Processor (hereafter referred to as the ORDA system). This first phase will establish a minimum "open system" user capability based on legacy NEXRAD Build 10 functionality and approved change requests.

The ORDA project is rehosting the functionality of the current application software (Concurrent OS/32 based) to run on an open system UNIX/LENOX platform. In addition, the ORDA program is developing new signal processor software to run on new hardware. The development approach for the ORDA project differs from that of the ORPG and OPUP projects. For the ORDA project, OST will use the ORDA Proof of Concept (POC) that the National Severe Storms Laboratory (NSSL) developed as a guide for determining ORDA design requirements. This POC system will allow OST to competitively procure a commercial system that includes the agreed-upon set of functionality, nominally

considered to be of higher technical risk. OST may defer some functionality to the follow-on production development effort.

Upon satisfactory demonstration of the POC system, the Government established a program and technical team composed of the National Weather Service (NWS), NSSL, the Radar Operations Center (ROC), and the ORDA Contractor to complete the design, development, test, and deployment of the ORDA system. Section 3 of this SEMP describes specific roles and responsibilities of the participating Government and Contractor groups.

1.2 Purpose of the Systems Engineering Management Plan

This section describes the purpose of this document and presents the historical context and underlying assumptions for the plan. The SEMP is a top-level description of the engineering management strategy, methods, and processes that will guide development the ORDA system. This plan will serve as the top-level plan that describes the engineering management approach for design and development of the ORDA. The SEMP does not contain detailed procedures for system hardware and software development. This information is contained in more detailed project documents referenced herein.

This plan acknowledges that a significant amount of the requirements analysis and design work has taken place in the initial NEXRAD implementation. The operation and maintenance of NEXRAD and the ORDA POC design provides substantial experience for this effort. These efforts contribute to the requirements and design phases of the ORDA project.

This SEMP will be a living document. As the program makes advances in the system development area, and as lessons are learned in the application of this document, this SEMP will be updated following guidance in the ORDA Documentation Plan (ODP).

1.3 Document Overview

This section presents a brief overview of the contents of the ORDA SEMP.

The SEMP provides for overall technical and administrative direction and monitoring of the ORDA project during the system's development cycle. The following provides a summary of each section contained within this SEMP.

- Section 1 identifies the ORDA project, and describes the purpose and summarizes the contents of the ORDA SEMP

- Section 2 lists the referenced documentation to which this document refers for further information

- Section 3 outlines and describes the organizational structure and the technical program planning and control for the ORDA project

- Section 4 provides the general systems engineering guidance to be used for the ORDA project

- Section 5 identifies and defines the integration and coordination of the program efforts for engineering specialty areas

- Section 6 lists the abbreviations, acronyms, definitions used, and other non-mandatory information referenced within the document

The Defense Systems Management College's – Systems Engineering Fundamentals, Chapter 16 defines ORDA SEMP requirements. This document follows those guidelines. The project team tailored the guidance in 499A for specific application to the ORDA effort.

1.4   Relationship to Other Standards and Plans

This section identifies and briefly describes several standards and plans that affect the development or acquisition of system improvements following the NPI Project Plan. The program office considers these plans as directive in nature and provides the management guidance that program managers, systems engineers, and team leaders are to follow in executing the project.

- ORDA Documentation Plan (ODP)
- System Development Plan (SDP).
- Implementation/Transition Plan (note: normally part of the SDP, although a transition plan is referenced in J-STD-016).
- Test and Evaluation Master Plan (TEMP). The following are several examples of plans which report to the TEMP:
    - o   Component Test Plan(s)
    - o   System Test Plan
    - o   Integration Test Plan
    - o   Acceptance Test Plan
- Security Plan.
- Risk Management Plan.
- Deployment/Retrofit Plan.
- Integrated Logistics Support Plan (ILSP), (this is an existing NEXRAD system support plan which must be updated to reflect any changes driven by the ORDA architecture and technology).

Section 2 of this SEMP identifies other higher-level plans that govern ORDA development, such as NEXRAD Program plans. ORDA software development will follow IEEE 12207, Software Life Cycle Processes, and Software Development

1.4.1   ORDA Documentation Plan

The ORDA Documentation Plan describes a "Managed Document (MD)" process for creating, managing, updating, and tracking the ORDA project documentation. Specifically, this plan establishes requirements for all documentation associated with ORDA system requirements, design, product, and lifecycle support. The MD process

described in the ODP will begin with a definition of the scope of a document, its purpose, and who is responsible for its creation, dissemination, and maintenance. The MD process results in a document that is stable and standardized for use as the basis for subsequent documentation and/or processes. The ODP will include, but is not limited to, intermediate level review by selected peers, agency review and OST approval for transition from draft to MD status. The ODP augments the WSR-88D Technical Data Management Plan (TDMP), ROCPLN-PGM-04, and follows ROC Plan Format Standard Dir-01.

1.4.2   System Development Plan

The NWS Office of Science and Technology (OS&T) and the ORDA contractor are responsible for leading the preparation of an ORDA System Development Plan (SDP). The ORDA SDP will include a description of the ORDA system, hardware, and software development process. The Software Development Plan cited in J-STD-016-1995 is an acceptable model for the ORDA SDP. The SDP can include, but is not limited to:

- Standards and practices/conventions used for hardware and software development
- Plans for resource organization, procurement, allocation, and/or reservation. Resources include test equipment, software development platforms (associated hardware and software), test facilities, office/lab space, and personnel
- Plans for lower-level, internal review of work and integration of modules
- Handling of critical requirements
- Internal project configuration control of hardware and software units
- Process for integration of hardware and software items

The intent of the SDP is to document the roadmap that the developer plans to follow.

1.4.3   Implementation/Transition Plan

The NWS WSR-88D ROC will develop an ORDA Implementation/Transition Plan that will describe the preconditions for transition of the project from Design/Production/Deployment to agency Operations & Maintenance (O&M) support. It will encompass deliverable hardware and software items and include life cycle support issues. The program office must generate this Implementation/Transition Plan before the Test Readiness Review (TRR).

The Implementation/Transition Plan should conform to the ORDA system implementation concepts as described in the SDP. The software portion of the system Implementation/Transition Plan will follow the requirements of J-STD-016.

1.4.4   Test and Evaluation Master Plan

The ORDA subsystem Test and Evaluation Master Plan (TEMP) describes how the Government intends to ensure the availability and stability of the WSR-88D system through a formal test program of the ORDA functional area. It will describe the overall test program that verifies that the ORDA project achieved all functional and operational requirements. This plan identifies the OS&T, NSSL, ROC, and contractor organizations,

defines their roles, presents the general approach of the test program, defines the types of tests, types of equipment needed, the test planning and scheduling process, and the needed test documentation. It also addresses the verification of requirements with the use of the Dynamic Object Oriented Requirements System (DOORS) to ensure requirements traceability. It also addresses the test preparation, execution, and reporting process, and the certification of external system interfaces. In summary, this TEMP address all phases of the test program from requirements verification to the customer's on-site acceptance of the ORDA.

This TEMP is tailored from the format defined in Chapter 16 (Test and Evaluation Management Plan) of the Defense System Management College (DSMC) Test and Evaluation Management Guide (TEMG, dated: March 1998). This guide defines DOD Standard 5000.2-R, Mandatory Procedures for Major Defense Acquisition Programs (MDAPS) and Major Automated Information System (MAIS) Acquisition Programs; 10 June 2001, as the necessary guides to use as the model for a TEMP. The DSMC TEMG states that a TEMP needs to be a short, dynamic, and working document. Several other commercial and military standards are value added in their contributions as guides to design in the TEMP for specific content and format.

1.4.5   Security Plan

The ORDA Security Plan will document the method or process by which the ORDA project intends to satisfy the security requirements (e.g., physical, access control, network) imposed on the ORDA system. The ORDA System Specification identifies the requirements. The Security Plan will also document how the ORDA project will verify that the security requirements have been satisfied. The plan will include all phases of the ORDA project from development to deployment. For each requirement, the plan will document:

- The standard and/or agency imposing the requirement
- The method by which the ORDA system intends to satisfy the requirement, in as detailed a description as permissible
- The method by which the ORDA system intends to verify that the requirement has been satisfied, in as detailed a description as permissible

Section 5.4 of this SEMP provides additional details of the ORDA Security Plan and its integration with other ORDA engineering specialty areas.

1.4.6   Risk Management Plan

The ORDA Risk Management Plan describes risk planning, identification, analysis, handling, monitoring, and reporting in a qualitative manner during the project life cycle. The plan defines the concepts of risk management for the ORDA Project, to include risk identification, estimating the probability of occurrence, estimating potential consequences, and developing risk mitigation proposals. The ORDA Risk Management Plan describes programmatic product and management risks. The plan reflects program concerns. It describes the application of an iterative risk assessment process at all Work

Breakdown Structure (WBS) levels for each identified risk as the ORDA design progresses. The plan defines the process for performing risk management within ORDA. Section 3.5 of this SEMP describes the risk management process at a high level, and identifies the different approaches for addressing management and technical risks. The main guideline to generate this plan is the Defense Systems Management College's – Systems Engineering Fundamentals.

1.4.7   Deployment/Retrofit Plan

The plan addresses capability, performance improvements, and the correction of identified deficiencies. The Deployment/Retrofit Plan establishes organizational roles, responsibilities, planning and tracking of deployment/retrofit activities, the minimum documentation content supporting system deployment and retrofit, and deployment/retrofit implementation procedures. Unless otherwise specified by the ORDA Project Team, the Deployment/Retrofit Plan will follow ROCPLN-PGM-02.

1.4.8   Integrated Logistics Support Plan

The ORDA Integrated Logistics Support Plan describes the organizational roles and responsibilities, the support and training activities, and guidelines for managing personnel, spare assets, special equipment, and line replaceable units (LRUs) for the ORDA system. The ROC maintains this plan as a living document and updates it in a controlled fashion to reflect experience gained and evolving logistic support system requirements. OST will update the ILSP that describes the support aspects of the ORDA.

2 Applicable Documents

This section lists the "applicable" and "reference" documents by title, document number, issuing authority, revision, and when applicable, change notice amendment number, and date of issue. These documents are listed for guidance purposes, but are not directive. Project direction is contained in the documents listed in section 1.4 of this SEMP. In many cases, the project team will tailor the guidance contained in the following documents to efficiently apply them to the ORDA.

a. NEXRAD Product Improvement (NPI) Project Plan, 22 October 2001
    Issued by: NWS OS&T

b. Systems Engineering Standard, EIA/IS-632, January 1999
    Issued by: Electronic Industries Association (EIA)

c. J-STD-016-1995, Software Life Cycle Processes, Software Development, September 1995
    Issued by: Department of Defense

d. MIL-STD-937, Configuration Management, 17 April 1992
    Issued by: Department of Defense

e. WSR-88D System Specification, 31 October 2001
    Issued by: WSR-88D Radar Operations Center (ROC)

f. WSR-88D Configuration Management Plan
    Issued by: WSR-88D ROC

g. NEXRAD Operational Support Facility Software Quality Assurance Plan
    Issued by: WSR-88D ROC

h. NEXRAD Operational Support Facility Hardware Quality Assurance Plan
    Issued by: WSR-88D ROC

i. NEXRAD Operational Support Facility Technical Data Maintenance Plan
    Issued by: WSR-88D ROC

j. Federal Meteorological Handbook No. 11, FMH-11
    Issued by: NWS

k. Advanced Weather Information Processing System (AWIPS) System/Subsystem Design Description
    Issued by: NWS

l. POSIX.1 Portable Operating System Interface, ISO Standard 1003.1-1990
    Issued by: International Standards Organization (ISO)

m. POSIX.4 Real-Time Extensions, ISO Standard 1003.1b-1993
    Issued by: ISO

n. Open Systems Interconnection (OSI) Standard
    Issued by: ISO

o. Draft Open Radar Data Acquisition System Development Plan (Version 0.1)
    Issued by: NWS

p. Draft NPI ORDA Memorandum of Understanding between OS&T and the NSSL for
    FY 2001
    Issued by: NWS OS&T

q. Draft NEXRAD ORDA Test and Evaluation Master Plan (TEMP), 23 November
    2001
    Issued by: NWS OS&T

r. WSR-88D Modification/Retrofit Management Plans
    Issued by: WSR-88D ROC

s. NEXRAD Integrated Logistics Support Plan (ILSP), R400-IS302B, 30 October 1993

t. IEEE/EIA 12207, Software Life Cycle Processes, March 1998
    Issued by: Institute of Electrical and Electronics Engineers (IEEE)/EIA

u. MIL-STD 490A, Specification Practices, October 1968

v. MIL-STD 1521B, Technical Reviews and Audits for Systems, Equipments, and
    Computer Software, June 1985

w. System Engineering Fundamentals, Supplementary Text prepared by the Defense
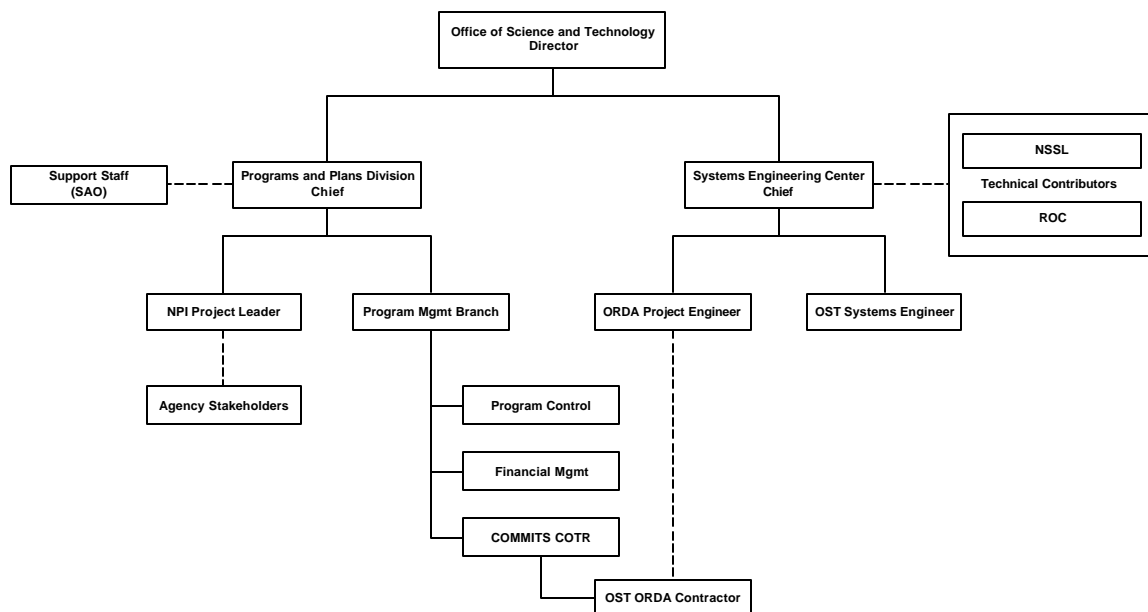   Acquisition University Press, Defense System Management College; January 2001.

3 Technical Program Planning and Control

This section identifies organizational responsibilities and authority for ORDA system engineering management. It includes a description of project management activities including technical planning.

Under the tri-agency program management of the WSR-88D System, the NEXRAD PMC will have the responsibility for approving proposed NPI system changes by the user agencies, including the ORDA project. The NPI Program began in fiscal year (FY) 1993 as part of the NEXRAD JSPO Product Improvement (PI) Program and transitioned to the NWS Office of System Development (OSD) in FY 1994. Since the program's inception, the NWS has identified, prioritized and scheduled candidate evolutionary steps for NEXRAD. They established teams for the execution of the NPI Program, established funding requirements for the effort, and solicited the cooperation and involvement of the remaining partners in the NEXRAD program: the Department of Defense, represented by the U.S. Air Force, and the Department of Transportation, represented by the FAA.

Program management responsibility for the NPI activities resides with the NWS Office of Science and Technology (OST). The OST has assigned overall management and funding responsibility for the program to the Programs and Plans Division (PPD) and overall technical ORDA project responsibility to the Systems Engineering Center (SEC). PPD will assign an NPI Project Leader that will oversee all NPI programmatic aspects. The SEC will use various standards for conducting all engineering activities, including WSR-88D System Modification/Retrofit Management Plan and the ROC Configuration Management Plan processes and procedures. Figure 3-1 shows OST management and technical organization that support the ORDA project. Sections 3.1 provides details of the ORDA organization.

Figure 3-1 OST ORDA Program Structure

The OST PPD chief will serve as the NPI Program Manager for the ORDA project. The PPD will assign an NPI Project Leader (PL) to coordinate and lead the day-to-day planning and management of the ORDA project.

The OST SEC will lead the technical activities of the ORDA project. The SEC will assign an ORDA Project Engineer (PE) to coordinate and lead the technical planning and management of the project. The ROC, NSSL, and the ORDA contractor will provide direct technical support and assist in the allocation and management of resources.

The ROC and NSSL will provide direct support to OST by assisting in the identification and management of resources, providing technical radar guidance and definition of project deliverables.

3.1.2.1   NPI Project Leader (PL)

The PL is responsible for ensuring the implementation of each agency's requirements in the ORDA system. The PL will work with other staff within the PPD to plan and execute the program within the budget and schedule approved by the PMC. The NPI PL has overall responsibility for ensuring that the developed and deployed ORDA system meets each agency's requirements within the budget and schedule approved by the NEXRAD PMC. NPI Project Leader responsibilities include:

- Oversee development of detailed project plans (activities, detailed roles and responsibilities, resource requirements, deliverables and schedule)
- Coordinate with the ROC and other NWS management focal points
- Assist in the preparation of project status briefings for the PMC and agency focal points (briefings generally to be given by the NPI Program Manager)
- Work with the Commerce Information Technology Solutions (COMMITS) Contracting Officer's Technical Representative (COTR) and ACOTR to define and implement tasking for the ORDA contractor
- Provide overall program management to include:
  - Coordination of planning and activities to ensure consistency with tri-agency modernization plans
  - Formulation and defense of tri-agency budgets for the NPI Program
  - Management of program funding
  - Providing a point of contact for coordinating and implementing the NSSL/NWS MOU
  - Conduct quarterly program status reviews, to include the following tasks:
    - Notify the PMC in a timely manner of any projected negative impacts to the program baseline (e.g., schedule slips, funding/performance shortfalls)
    - Assist in the preparation of project status briefings for the PMC and agency focal points (briefings generally to be given by the NPI Program Manager)
- Monitor the technical program, to include the following tasks:
  - Work closely with the ORDA Project Engineer to ensure that adequate technical planning is conducted

- o Collect and review weekly status reports
- o Attend all formal design reviews, requiring formal approval to accept the design before proceeding to the next technical phase
- o Ensure all formal documentation is adequately reviewed

3.1.2.2 ORDA Project Engineer

The ORDA PE has the primary technical responsibility for the ORDA project. The ORDA PE responsibilities include:

- Lead day-to-day technical management and execution of the ORDA project
- Coordinate with the individual technical team leads
- Oversee the development of detailed task plans, working with the technical team leads
- Serve as task manager of the ORDA contractor and other task teams, with the additional title of Associate COTR (ACOTR)
- Monitor the technical program
  - o Work closely with the technical teams to ensure that the technical program progresses as planned
  - o Collect status and provide weekly status reports to Technical Management, Program Management, and the Directors of NSSL, ROC, and OST
  - o Prepare and present the technical status of the project to various ORDA and NEXRAD Program stakeholder meetings that maybe held
  - o Attend all formal design reviews, requiring formal approval to accept the design before proceeding to the next technical phase
  - o Ensure all formal documentation is adequately prepared and reviewed

3.1.3   Program Responsibility

This section summarizes major program activities and allocates system level responsibilities for each. It provides general guidance to each functional activity to enhance ownership and coordination of activities. The following matrix provides guidance for each office on their level of responsibility for the ORDA program. The program office will use this matrix to clarify roles and allocate resources. Properly used, this matrix will discourage the sequential approach for product development and allow for a shared concurrent engineering approach. This approach entails the active involvement of all relevant specialty areas throughout the design and development process. Table 3-1 provides a quick reference as to Responsible (R), Coordinating (C), and Approval (A) roles for each of the major players on the ORDA project.

OFFICE EVENT	PL	PE	ROC	Contractor	PMC
Project Objectives	A	R	C	C	C
Milestones	A	R	C	C	C
Requirements	C	R	A	C	A
Specifications	C	A	C	C	C
Reviews	C	A	C	R	C
Financial	A	R	C	R	C
Testing	C	A	**R≥** **System**	**R≤** **Integration**	C
Manufacturing	C	A	A	R	C
Support	C	A	C	R	C
Documentation	C	A	C	R	C
Installation Schedule	A	C	C	R	C
Training	C	A	C	R	C

TABLE 3-1 RESPONSIBILITY MATRIX

3.2 Objectives

This section describes the objectives of the ORDA project, the system engineering approach and development concept. The system engineering approach defines the program phases that represent the traditional system acquisition model.

The system engineering approach for the ORDA project must conform to the overall NPI system engineering approach. The system engineering approach for the NPI Program is an iterative process throughout the system life cycle. This approach defines problems, translates new requirements into design requirements and provides an integrated system solution. Problems generally consist of deficiencies in performance, operations and support. New requirements result from new meteorological algorithms or enhancements to existing algorithms. Solutions may involve existing or emerging technologies transitioned from technology base to operational application.

The NPI Program consists of several incremental projects, including the ORDA project, characterized by development, acquisition, and deployment of clearly defined system modifications. The NPI Program Office will manage each individual increment using a

series of phases and milestone decision points to facilitate the development of a stable design that meets agency mission needs and can be fielded within the schedule and budget imposed by the user agencies.

The ORDA project will use a top-down, requirements-driven systems engineering approach. The basic structure of each project will be a modification of the traditional acquisition model tailored to account for the commercial-off-the-shelf (COTS)/non-developmental item (NDI) focus of the NPI Program.

3.3   Formal Technical Reviews

This section describes the formal technical reviews to assess the degree of completion of technical efforts related to major milestones before proceeding with further technical effort. The NPI Program Manager may convene additional milestone reviews should circumstances make them necessary.

3.3.1   ORDA Program Phases

The NPI Program Office has defined five production phases to control, monitor and fund the ORDA program. The NPI Program acquisition model has four high-level phases. These four phases will encompass the technical reviews.

PHASE	DEFINITION
Proof of Concept	All design activity before formal System Design Review (SDR) Concept Exploration
Prototype Phase	Begins after SDR and ends with Integration Test Readiness Review (ITRR) Engineering and Manufacturing Development
Production Phase	Begins after ITRR and ends with Deployment Readiness Review (DRR)
Deployment Phase	Begins after DRR and ends with the last site installation and acceptance

TABLE 3-1 ORDA DEVELOPMENT & PRODUCTION PHASES

Major milestones authorize the program to proceed to the next phase. The PMC will authorize the program to proceed to the next phase. Figure 3-2 illustrates the four phases and the associated milestones for program management.
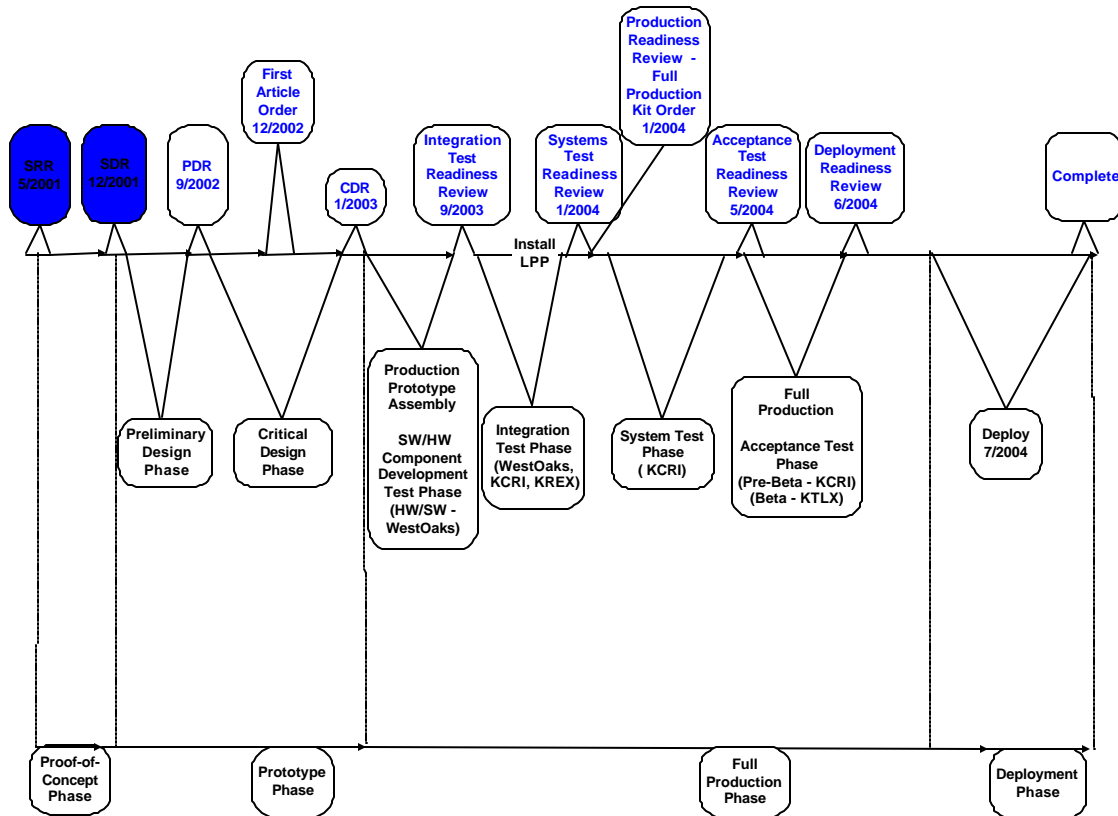
Figure 3-2 PROJECT PHASE DEFINITION

3.3.1.1   Proof of Concept Exploration

Concept exploration focuses on the evaluation of the feasibility of alternative concepts to meet user requirements and results in the identification of a preferred (most promising) system concept. In general, this phase is a technical study of various technical alternatives to meet user requirements.

3.3.1.2   Prototype Phase

The Prototype Phase authorizes design and development activities to build a prototype of the hardware and software. This includes the ORDA Requirements and System Design analysis, consisting of the specification, design, development, demonstration, and delivery of appropriate product documentation. Prototypes will test detailed design, development issues, and conduct Integration Testing Readiness Review before progressing to the next phase. The goal is to assess the risks of achieving the required performance within the cost and schedule constraints imposed by the user agencies. After the Project Engineer conducts a System Design Review, the PMC will authorize Prototype Phase. The Prototype Phase will end after it has successfully passed the Integration Test Readiness Review. This test provides the user community assurance that the prototype meets system requirements.

3.3.1.3 Production Phase

The purpose of the Production Phase is to translate the prototype into a stable, producible, supportable, and cost-effective design that meets the ORDA program requirements. This phase includes the procurement of eleven First Article systems to validate the design, assembly and installation procedures an ORDA system. The Project Engineer will install these First Articles at the following locations. The Program Engineer and the Radar Operations Center will conduct the Production Readiness Review before the PMC authorizes the program to proceed to the Full Production Phase.

LOCATION	NUMBER
National Reconditioning Center	Two (2)
NWS Training Center	Four (4)
Air Force Education Training Center	Two (2)
KCRI Test Bed	Two (2)
OST West Oaks	Four (4)
KREX Test Bed	One (1)
ROC Software Development Facility	One (1)
KOUN (NSSL)	One (1)

This phase also includes ordering the full production of ORDA installation kits and conducting of System and Acceptance (pre and Beta) Test. After the Acceptance Test the ROC will conduct FCA/PCA audits and OST will conduct the Deployment Readiness Review. The objective of this high-level phase is to fully test the design and prepare for deployment to the sites. After the Deployment Readiness Review, the PMC will authorize Deployment Phase.

3.3.1.4 Deployment Phase

The NPI Project Lead will develop the approved schedule for site installation and use the ORPG Deployment Plan as a guide. The ORDA contractor will be responsible for installing all ORDA modification kits.

3.3.2 ORDA Formal Reviews

The NPI Program Office tailored the major technical reviews in EIA-632 (Processes for Engineering a System) and MIL-STD-1521B (Technical Reviews and Audits for Systems, Equipments, and Computer Software) to meet the program requirements. The NPI Program Office considers successful completion of each technical review a major

milestone for the ORDA project. The ORDA Project Engineer will provide these technical reviews to the PMC along with a review of plans for the next phase of the acquisition. The PMC will evaluate project status at each milestone, assess progress, authorize the next phase, and approve exit criteria for successful completion of the next acquisition phase. The ORDA Project Engineer will conduct the following reviews at the system and subsystem level during ORDA design and development.

- Proof-of-Concept Review (POC)
- System Requirements Review (SRR)
- System Design Review (SDR)
- Preliminary Design Review (PDR)
- Critical Design Review (CDR)
- Test Readiness Review (TRR)
- Functional Configuration Audit (FCA)
- Physical Configuration Audit (PCA)
- Production Readiness Review (PRR)

3.3.2.1   Proof-of Concept Review

The NPI program will conduct an assessment of the NSSL POC and determine how to use this work to guide the development of the ORDA.

3.3.2.2   System Requirements Review (SRR)

The SRR will determine progress in defining system technical requirements, program/design requirements, and for implementing other engineering management activities. The NPI Program Office will conduct the SRR during the ORDA Proof of Concept Phase. It will review the updated System Specification, all appropriate Interface Requirements Specifications, and relevant project standards and procedures. At the successful completion of the SRR, a system requirement's baseline will be developed and managed as a reference for future development activities.

3.3.2.3   System Design Review (SDR)

The SDR will evaluate the correlation, completeness, optimization potential, and risks associated with the allocated program/design requirements as documented in the System/Subsystem Specification and the System/Subsystem Design Description. The Project Engineer will conduct the SDR to formalize system characteristics and allocate configuration identification. The SDR will be in sufficient detail to ensure a technical understanding among all participants on:

- The updated or completed System/Subsystem Specification
- The updated or completed System/Subsystem Design Description
- Other system definition efforts, productions, and plans
- The preliminary configuration item (CI) development specifications

A successful SDR will establish the functional baseline that the Program Office will manage as a reference for future development activities.

3.3.2.4   Preliminary Design Review (PDR)

The PDR will ensure that sufficient technical and management information is available for incremental and independent assessment of ORDA configuration items (CIs).

3.3.2.5   Critical Design Review (CDR)

The CDR will provide an approved design that is ready for final prototype, development, procurement and verification activities. The Project Engineer will conduct this review on each configuration item before production/coding release to insure that the detail design solutions satisfy all requirements established by development specifications. The primary product of the CDR is a formal identification of specific software documentation for coding and testing.

3.3.2.6   Test Readiness Review (TRR)

The ORDA Contractor will conduct TRRs at the beginning of the integration Test Phase as described in the TEMP. The ROC, with contractor support, will conduct TRRs at the beginning of the system and acceptance Test Phases as described in the TEMP.

3.3.2.7   Functional Configuration Audit

The ROC will conduct the Functional Configuration Audit (FCA) during the Full Production Phase in conjunction with Acceptance Test. The FCA is an audit at the subsystem level to validate that the CIs have been satisfactorily completed and that they have achieved the performance and functional characteristics specified in the functional or allocated identification.

3.3.2.8   Physical Configuration Audit

The ROC will conduct the Physical Configuration Audit (PCA) during the Full Production Phase in conjunction with the Acceptance Test. The PCA, which always follows an FCA, is an examination that verifies conformance of the as-built version of a CI against its design documentation. The PCA will confirm that:

- Baseline items at the system-level
- Required changes to previously completed baselines have been implemented (e.g., deficiencies discovered during testing have been resolved and implemented)
- System processes are current, can be executed, and meet the need

3.3.2.9   Production Readiness Review

A PRR provides the status of completion of the specific actions to satisfactorily accomplish executing a go-ahead decision. The PRR will review the PMC authorizes the Full Production Phase. The NPI Program will use the PRR to refer to either type of review decide if the system is in a suitable condition for delivery to the acquirer.

3.4   Development of Work Breakdown Structure

This section describes the top-level ORDA work breakdown structure (WBS) that serves as the fundamental reference for tracking performance of the ORDA project and project cost analyses. The WBS elements of the project in a hierarchical framework and establishes their relationships to the project end items. This hierarchical structure facilitates evaluation of cost, time and technical performance at all levels in the organization over the life of the project.

The WBS also makes it possible to plan, schedule, and budget. It gives a framework for tracking cost and work performance. Use of the structure provides the opportunity to "roll-up" (sum) the budget and actual costs of the smaller work packages into larger work elements so that performance can be measured by organizational units and work accomplished. It also defines communications channels and assists in understanding and coordinating many parts of the project. This structure builds the Master Schedule that shows the work and organizational units responsible and suggests the direction of written communications. It allows program management to quickly address and coordinate problems because the structure integrates work and responsibility.

Appendix A provides a two level WBS for the ORDA project.

3.5   Program Risk Analysis

Program management will ensure that the ORDA program has a process in place to proactively identify, assess, and mitigate risks. The ORDA Risk Management Plan identifies specific activities describing the risk management process and is consistent with current industry standards for Risk Management. The NPI Project Engineer is responsible for identification, reporting, tracking and enabling risk mitigation challenges. The Project Lead will reports the results of these efforts to OST on a periodic basis or as required.

3.6   WSR-88D Test Planning

The Project Engineer will ensure that the contractor establishes and conducts an effective test and evaluation program to validate and verify WSR-88D requirements. The ORDA Test and Evaluation Master Plan (TEMP) provides a detailed comprehensive and methodical test and evaluation program that meets the needs of all WSR-88D system stakeholders. It is consistent with current industry standards for Test and Evaluation. The Project Engineer is responsible for establishing an effective test and evaluation program that provides early defect prevention, detection, resolution and reporting throughout the test program. The Project Lead reports the results of these efforts to OST Program Office on a periodic basis or as required.

3.7   Contractor Reviews

This section describes the relationships and review responsibilities between the Government and contractors performing tasks or delivering goods and services to the Government. This section provides some general guidance for project management, however the contract is the final authority for all tasking and any required reviews. The Project Engineer will formally review contractor developed equipments and Configuration Items (CI's). These reviews and all interactions with the contractor are the responsibility of the contracting officer and his or her designated representatives. The Project Engineer provides the written specifications, test criteria, configuration information, and quantities that the contractor will procure. The Contracting Officer's Technical Representative (COTR) will assist the Contracting Officer in managing these efforts.

3.8 Documentation Control

The primary mission of documentation control is to assist configuration control with cataloging design changes in order to:

- Ensure repeatability of present-day results by the Government or their designated "Independent Verification & Validation" provider,

- Ensure reproducibility of past demonstrated results for future retest needs, and

- Responding proactively to design changes.

The Statement of work will contain the CDRL list and associated deadlines, and subsequent negotiations will establish the documentation assignments. Data format and storage will be compatible with DOORS, Agile, and Razor. The Government (ROC CM) will assign configuration item data item control numbers. The Contractor will control programmatic documentation and internal work practices. The ORDA CM Plan will define Configuration Status Accounting.

3.9 Program Accomplishment

This section describes how the components of the ORDA system will be accomplished, focusing on roles and responsibilities for procurement of the approved hardware and software components. For the ORDA system, the contractor will follow approved plans to accomplish the procurement of production hardware and software components. Procurement activities may use pre-competed contracts, or by purchasing agreements made by the contractor, whichever is most cost effective to the Government. The ORDA contractor will provide all labor associated with the procurement and deployment, consistent with the contractors approved Statement of Work.

The Program Office will use ROC developed WSR-88D CM and Modification/Retrofit Management Plans, approved by the tri-agencies, to correct deficiencies and improve the capabilities of the WSR-88D in a logical and orderly manner. All NPI projects, including the ORDA project, fall under the scope of the CM and Modification/Retrofit Plans and guide NPI modifications.

3.10 Integrated Logistics Support Concept

This section describes the integrated logistics support over the life cycle of the ORDA project, with emphasis on organizational roles, responsibilities, and required activities. In many respects, the current Integrated Logistics Support (ILS) Concept for the WSR-88D System will not change substantially because of the NPI Program or the ORDA project. Organizational maintenance will continue to be the responsibility of each NEXRAD agency, and maintenance actions will consist of removal and replacement of Line Replaceable Units (LRUs). The NPI Program Office believes that the ORDA project, with its emphasis on continuous system evolution with COTS components, could add flexibility to the depot sparing philosophy. The NPI Program will review the Next Generation Weather Radar Maintenance Concept (RG400-MC202 dated February 1984) and submit updates or changes to the ROC.

The overall roles of the WSR-88D Radar Operations Center (ROC), National Reconditioning Center (NRC) and the National Logistics Supply Center (NLSC) in support of fielded systems will remain unchanged. The continuous evolution of COTS components will necessitate a large role for ROC/NRC/NLSC in validating component upgrades for compatibility with other parts of the WSR-88D, or for identifying any WSR-88D changes required for use of the new components. The ROC will also work with the agency maintenance training centers to provide required maintenance training to field sites. The ORDA contractor will prepare training material described in the contractor's approved Statement of Work.

4   Systems Engineering Process

This section provides some general materials that may be valuable to the overall system engineering approach for developing the ORDA system. This section is not a directive, but rather is advisory. Project managers can choose to use this information as applicable or they can make use of other excellent systems engineering guidance available in the literature.

The systems engineering process is a top-down comprehensive, iterative and recursive solving process, applied sequentially through all stages of development that:

• Transforms needs and requirements into a set of system product and process descriptions (adding value and more detail with each level of development),

• Generates information for decision makers, and

• Provides input for the next level of development.

The fundamental systems engineering activities are Requirements Analysis, Functional Analysis and Allocation, and Design Synthesis—all balanced by techniques and tools collectively called System Analysis and Control. Systems engineering controls are used to track decisions and requirements, maintain technical baselines, manage interfaces, manage risks, track cost and schedule, track technical performance, verify requirements are met, and review/audit the progress.

The Systems Engineering Process is applied sequentially, one level at a time, adding additional detail and definition with each level of development. As shown by Figure 4-1, the process includes: inputs and outputs; requirements analysis, functional analysis and allocation; requirements loop; synthesis; design loop; verification; and system analysis and control.

The overall system engineering approach is an iterative process throughout the system life cycle where we translate operational and new requirements into design requirements and an integrated system solution. Problems generally consist of deficiencies in performance, operations, and support. New requirements result from new meteorological algorithms or enhancements to existing algorithms. Solutions may involve existing or emerging technologies transitioned from technology base to operational application. Jointly, acquiring and development elements will define transition criteria and application methods. During the systems engineering process, architectures are generated to better describe and understand the system. The word "architecture" is used in various contexts in the general field of engineering. It is used as a general description of how the subsystems join together to form the system.

Life Cycle Integration

Integrated development should achieve life cycle integration—that is, concurrent consideration of all life cycle needs during the development process. Concurrent consideration of all life cycle:
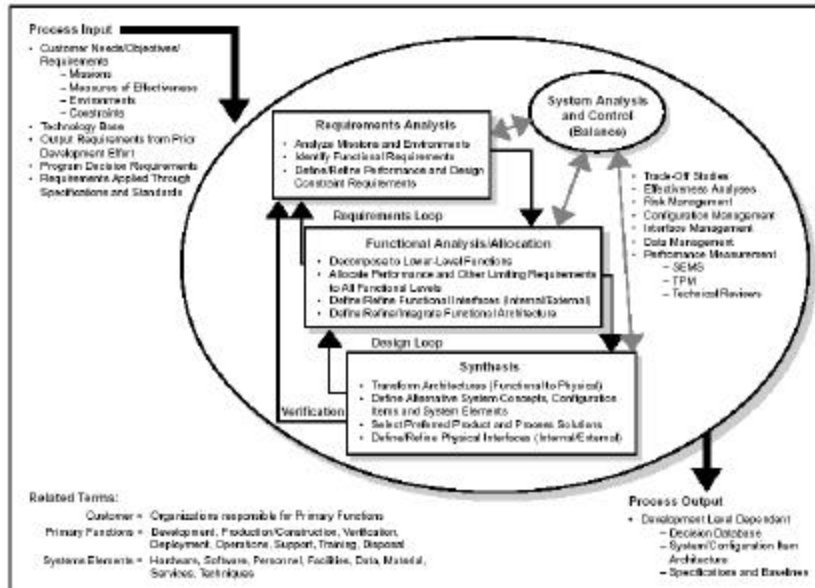
FIGURE 4-1 The Systems Engineering Process

• Produce a design solution that satisfies initially defined requirements, and

• Communicate that design solution clearly, effectively, and in a timely manner.

• Place balanced emphasis on product and process development, and

• Require early involvement of all disciplines appropriate to the team task.

Life Cycle Functions Life cycle functions are the characteristic actions associated with the system life cycle. They are development, production and construction, deployment (fielding), operation, support, disposal, training, and verification. These activities cover the "cradle to grave" life cycle process and are associated with major functional groups that provide essential support to the life cycle process. We refer to them as the eight primary functions of systems engineering. The customers of the systems engineer perform the life-cycle functions. ORDA designers will emphasize the system user's needs because they generate the requirement for the system. All of the life-cycle functions generate requirements for the systems engineering process once the user has established the basic need.

System Engineering Systems engineering is a standardized, disciplined management process for development of system solutions that provides a constant approach to system development in an environment of change and uncertainty. It also provides for simultaneous product and process development, as well as a common basis for communication. Systems engineering ensures that the correct technical tasks are done during development through planning, tracking, and coordinating. Responsibilities of systems engineers include:

• Development of a total system design solution that balances cost, schedule, performance, and risk,

• Development and tracking of technical information needed for decision making,

• Verification that technical solutions satisfy customer requirements,

• Development of a system that can be produced economically and supported throughout the life cycle,

• Development and monitoring of internal and external interface compatibility of the system and subsystems using an open systems approach,

• Establishment of baselines and configuration control, and

• Proper focus and structure for system and major sub-system level design.

Problems generally consist of deficiencies in performance, operations, and support. New requirements result from new meteorological algorithms or enhancements to existing algorithms. Solutions may involve existing or emerging technologies transitioned from technology base to operational application. Jointly, acquiring and development elements will define transition criteria and application methods.

The overall NPI Program system engineering process consists of three primary tasks performed in an iterative manner. This NPI system engineering process should also apply to the component projects, including the development of the ORDA system. The first task is analysis of the requirements that entails definition of performance and functional requirements and identification of design constraints. The second task is functional analysis and allocation. The third task is synthesis. Each aspect of the ORDA system acquisition subphases may accomplish of all these tasks. In general, however, the ORDA Requirements subphase will rely heavily on the first primary task activities, and the ORDA Development, Test, and Deployment subphases will rely principally on the third primary task activities.

4.1   Mission Requirements Analysis

This section describes the mission of the ORDA system and the high-level requirements to support that mission. It will consider and present activities, factors, roles, responsibilities and relevant standards for analyzing the requirements.

The primary mission of the ORDA system is to provide improved radar data processing and communications support to NWS meteorologists, hydrologists, and others to enable them to serve the public better. The increasing costs associated with maintaining proprietary system elements has led NWS to initiate the NPI Program to evolve the

components of the system to maintain currency with advancing technologies and address changing operational requirements. Transition from the existing proprietary platform to an open system environment requires fundamental architectural changes that the NPI Program Office and ORDA contractor must carefully plan and execute in consonance with ongoing modernization efforts such as AWIPS. Migration strategy relies heavily on an established operational infrastructure to streamline the development and implementation processes. In this way, the Government can postpone almost indefinitely the risk and expense of a major systems acquisition for an entirely new national weather radar system.

The NPI launched the ORDA project to facilitate near- and long-term improvements in the radar data acquisition area. The ultimate goals of this effort are to facilitate mitigation of Doppler ambiguities and provide polarimetric capability for the WSR-88D users. Achievement of these goals depends on successful replacement of the legacy signal processing and control platform in the RDA.

The Government will analyze all levels of the NWS in a top-down manner similar to previous studies to develop the NEXRAD operations concept and analyze requirements. OST will identify and analyze strengths, weaknesses, and emerging trends. The mission analysis will include an analysis of system and user needs, tasks and task sequencing, customer needs, performance requirements, and design constraints.

Some factors of prime importance in the operations concept are:

- Produce more accurate, timely, up-to-date, and detailed forecasts in all service areas
- Limited NWS personnel resources will require the automation of routine tasks
- Increased coordination is necessary among program areas and over geographic boundaries to reduce forecast conflicts
- Application of NEXRAD enhancements must have little impact on field operations
- System boundaries will retain the characteristics and functionality defined in the existing Interface Control Documents (ICDs) to the maximum possible extent

In analyzing mission requirements, the Government will lead the definition and documentation of the ORDA requirements. Specifically, the ROC will lead a team of ROC, SEC, and contractor staff who will define and document the system, subsystem, hardware, and software requirements. The specific documents to be created, the format and standards to be used, and the process for capturing, documenting, and reviewing these requirements will be defined by the team, in cooperation and with the approval of the TP&M staff. The role of the COMMITS contractor during this activity is not to write the requirements, but rather to assist the Government in the clear, accurate, and complete documentation of the requirements.

To produce a system that is portable, flexible, and expandable, the project will adhere to Government, national, international, and industry standards. The NPI Program Office will focus on open systems and pay particular attention to the National Institute of Standards and Technology (NIST) Application Portability Profile (APP). The NPI Program Office

will also encourage the use of open systems hardware and software, available as COTS or NDI equipment in the following areas:

- Hardware and software procurement—Use of open systems equipment allows the Government to take advantage of commercial software and configuration management tools and the associated market pressures that force down prices and increase product features and quality. It also provides for greater access to 'equivalent' spares
- Packaging, handling, storage, and transportation—The marketplace defines and tests the solution; no special design effort is required
- Labor and personnel—Market support is available to install and check out open system products. With manufacturers' warranties, agency maintenance staff can be assisted, as needed, by a manufacturer's on-site or telephone help desk technical staff
- Support equipment—Commercial organizations build product lines (e.g., calibration equipment, test equipment) to support the operation and maintenance of open systems products, eliminating the need for custom support equipment
- Training and training support—With tailoring, commercial organizations can use their general processes, procedures, techniques, training devices, and equipment to train maintenance personnel to perform the common system maintenance and upgrades typically done at local sites
- Maintenance planning—Use of open systems provides access to manufacturer's historical information on reliability, availability and maintainability that can be used to plan a cost effective maintenance program and logistics support

Although the focus of the initial project activities is on developing and applying an open systems environment, enhancements in system performance will address identified capacity shortcomings in the legacy system. The ORDA System Specification defines these new performance requirements and the baseline requirements of the legacy system.

4.2 Functional Analysis

This section describes a suggested basis for analyzing and decomposing the functions that the ORDA system must support. It provides procedures and activities to identify, classify, and characterize the functional decomposition of the ORDA system. This functional decomposition is a basis for developing or updating system specifications.

The ORDA contractor and associated Government staff will analyze existing NEXRAD and RDA system requirements, analyze and identify all missing or duplicate requirements. They will document all clarifications and assumptions for resolution. The NPI Program Office will conduct a System Requirements Review to ensure that the tri agency participants have a common understanding of the ORDA requirements. The SRR will validate and approve the system requirements that will become the ORDA System Requirements Baseline (SRB). The SRB may also include design-independent derived requirements that the SRR agreed to.

After baselining the ORDA requirements, an ORDA system engineering team will conduct a two stage functional analysis. First, they will divide SRB system requirements

into broad functional areas. Then analyze the requirements within each area in a top-down manner. The decomposition process will result in a hierarchical tree structure, where each functional area is a branch of the tree, and each unique system function is a node of the tree. They will document each node to describe its inputs, process, and outputs. The system engineering team will resolve issues and review all functional decompositions to ensure consistency across all functional areas (branches). They will capture the rationale for the functional decomposition process in a companion textual document.

The Functional Description (FD) is an outline of the tree structure that will be developed during the Functional Decomposition process. As the requirement's baseline, the ORDA SRB will be used as input for the Functional Decomposition process that establishes the FD. The FD then will serve as an input for the identification of configuration items and to produce the appropriate B-level Specifications.

4.3   Functional Allocation

This section describes the activities and procedures for allocating system requirements to support identified ORDA functions. Functional analysis decomposition will generate the functions. The allocation results in a mapping of system requirements to the various CI's and associated CPCI's.

After creating the functional tree structure, the system engineering team will allocate the system requirements to the functional nodes. The assignment process provides a traceable link between the SRB and the functional decomposition, and it identifies under- or over-populated functions.

Functions are analyzed by decomposing higher-level functions identified through requirement's analysis into lower-level functions. The performance requirements associated with the higher level are allocated to lower functions. The result is a description of the product or item in terms of what it does logically and in terms of the performance required. This description is often called the functional architecture of the product or item. Functional analysis and allocation allows for a better understanding of what the system has to do, in what ways it can do it, and to some extent, the priorities and conflicts associated with lower-level functions. It provides information essential to optimizing physical solutions. Key tools in functional analysis and allocation are Functional Flow Block Diagrams, Time Line Analysis, and the Requirements Allocation Sheet.

4.4   Synthesis

This section summarizes the synthesis process that translates functional allocations to physical design. The synthesis process consists of three activities: 1) system design, 2) subsystem/configuration item design, and 3) formal build.

The design of the ORDA system is to based upon the work done to date by NSSL on the POC system. The Government will lead the definition and documentation of the complete design of the ORDA.

During the System Design Activity within the ORDA System Design and Analysis subphase, the system engineering team develops the system context and architecture that forms the basis for the preliminary design work for subsequent activities. After completing this step, an SDR ensures that technical and management information is sufficient to support incremental and independent development of the ORDA system Cis and CPCI's. Successful completion of the SDR establishes the system design.

Design synthesis is the process of defining the product or item in terms of the physical and software elements that together make up and defines the item. The result is the physical architecture. Each part must meet at least one functional requirement, and any part may support many functions. The physical architecture is the basic structure for generating the specifications and baselines.

An important aspect of the formal build activity is the integration of the ORDA system components into a complete and testable NEXRAD system. This testing should include integration testing, system testing, and acceptance testing of the complete integrated system.

During this ORDA Development and Test subphase, testing and auditing activities confirm whether the build was successfully completed. A TRR verifies that the testing procedures for the build can commence. The System Test Readiness Review is also the gate to the FCA and the PCA. The FCA validates that the CIs are satisfactorily completed and that they achieved the performance and functional characteristics specified in the functional or allocated baseline. The PCA follows an FCA and serves as an examination that verifies that the as-built version of a CI conforms to its design documentation.

5 Engineering Specialty Integration

This section identifies and defines the integration and coordination of the program efforts for engineering specialty areas for the ORDA system. It also identifies all specialty program plans and is advisory in nature.

5.1 System Development Plan

The ORDA System Development Plan describes the system development methodology and strategies to illustrate how the resulting system designs can support the project goals. The ORDA design team will use established software engineering standards to facilitate concurrent development and integration and provide easier maintenance.

The overall design strategy supports open systems that use common hardware and software in a distributed environment. All development should meet the following goals:

- Open systems, including the use of open backplane bus standards—to avoid vendor dependence and to facilitate upgrades
- COTS software – to reduce development and documentation cost
- COTS hardware—to control cost and enhance life cycle maintainability
- Common architecture—to ease maintenance and upgrades at all sites
- Meet availability requirements

The ORDA design should result in a "retrofit kit" package that will reduce installation down time and to mitigate the risk of damage to an operational site during the retrofit process. ORDA developers should apply this software design strategy to the open system design methodology. For each of the software units or modules, they will use the following criteria to develop their subordinate computer program components, in order of priority:

- Like functionality—The CPCs will be designed to be functionally cohesive, with each function being similar in nature, but possibly operating on different data types
- Minimize interfaces—Interfaces between the CPCs will be kept to a minimum, to minimize the data flow between them. These first two criteria reflect the standard software engineering goal of designing loosely coupled but highly cohesive components
- Data and processing domains—Data within each CPC will be isolated from that of other CPCs. This allows for a modular design
- External software development support—The need to support the rapid introduction of science to the operational sites and its corresponding dependence on a pipelined software development approach makes the use of a standard application programming interface and a standard development methodology critical
- Testing—During CPC development, the testability of each assigned requirement will be evaluated

The software design strategy should reflect the following activities.
- Project purpose and scope

- Project goals and objectives

- Organization and responsibilities

- Management and technical controls

- Work definition and flow

- Development environment

- Software development and methodology

- Configuration Management

- Validation and Verification

- Quality Assurance provisions.

5.2   Test Planning

The Test Engineering Master Plan (TEMP) is the official authority for guidance on system testing activities. Test planning results in the development of a TEMP drives the Integration Test Plan, a System Test Plan, and Acceptance Test Plans. The objectives for testing the modifications planned for the ORDA system are:

- Provide confidence to the NEXRAD agencies that the modified ORDA system will meet their operational requirements
- Ensure that overall ORDA system reliability, usability, stability, and performance does not deteriorate as a result of modifying the system
- Ensure testing is conducted in a cost effective manner

To accomplish these objectives, testing for the ORDA system will focus on:

- Finding as many errors in the development and integration phases as possible, as early as possible in the test cycle, and before releasing the modification to the field. The earlier errors are found, the cheaper they are to fix
- Preventing software defects by promoting the adoption of proven defect prevention methods, such as formal inspections and walkthroughs throughout the development process
- Consolidating all formal test and certification activities to improve coordination and efficiency
- Reducing the amount of time and people required to perform testing for each modification release, while maintaining test effectiveness, by automating the execution of tests and the analysis of their results

Due to the increased reliance on software in the ORDA system, testing software reliability and maintainability is a key consideration, as well as testing of COTS and NDI products.

5.3   Deployment/Retrofit Plan

This section provides a brief, high-level description of the purpose and scope of a Deployment/Retrofit Plan for the ORDA system. It provides guidance for the activities, roles, and responsibilities in an ORDA Deployment/Retrofit Plan. The NPI Program Office will follow ROC approved retrofit plans Deployment/Retrofit guidelines.

Deploying NEXRAD enhancements throughout the continental United States, Alaska, Hawaii, and Puerto Rico involves complex planning, taking into account widely ranging differences in altitudes, climates, and facilities. Therefore, NWS has placed strong emphasis on a disciplined, well-thought-out approach to deployment planning and will exercise close management attention to schedule and to shipping, testing, and installation. The installation process must be sensitive to site needs and circumstances. Contractor planning will take all of these factors into account to ensure a reliable, low-risk field installation that results in minimal down time for operational sites. ORDA deployment planning will use the lessons learned from ORPG deployment.

An ORDA Deployment/Retrofit Plan should include the following activities and Government/contractor roles and responsibilities:

- Before beginning production, deployment, or retrofitting, the ORDA contractor should prepare and conduct a Production Readiness Review, following Government provided guidelines.
- Upon Government approval to proceed, the contractor will plan and perform deployment or retrofitting of all units, in cooperation with and approval by government planners
- The contractor will develop a deployment plan to minimize site down time during system installations, and avoid installations during periods of expected critical usage to be designated by the Government
- The contractor will prepare a disposition plan, to be approved by the Government, defining the use and/or disposal of replaced components
- The contractor will arrange for shipping of components to the site and for removal and disposal of all replaced or surplus equipment
- The contractor will conduct an onsite installation and checkout procedure
- A Government representative will witness onsite installation and checkout, assist with problem resolution, and provide information needed by the Government to sign acceptance documentation
- The contractor will leave the radar in a totally operational state
- The Government will provide support for certifying pre and post operations of the radar with WSR-88D Hotline at the ROC or onsite representatives.

5.4   Security Plan

This document will establish the development and test security policy for the Open Systems Radar Data Acquisition (ORDA) System following the guidance set by the Next Generation Weather Radar (NEXRAD) Weather Surveillance Radar – 1988 Doppler (WSR-88D) System Security Plan. It will update the NEXRAD WSR-88D System Security Plan at the end of ORDA system testing.

This document blends the computer security requirements set forth in Public Law 100-235, *Computer Security Act of 1987*; Office of Management and Budget (OMB), Circular A-130, *Management of Federal Information Resources*; DoD 5200.28-STD, *Department of Defense Trusted Computer System Evaluation Criteria; and applicable Department of Commerce (DOC), Department of Transportation (DOT) and Department of Defense (DoD) computer system security requirements.*

The specific objectives of this document are to:

- State all mandated security requirements that are applicable to the system and its operation.

- Provide guidance in the development and implementation of methodologies, techniques, and procedures, by which the system may prevent unauthorized access and/or manipulation of the system, its resources and/or its information, thus complying with all mandated security requirements.

- Serve as the source document for the testing criteria, as a means of judging the system's compliance with the mandated security requirements and established operational procedures.

5.5 System Support Planning

This section provides a brief, high-level description of the purpose and scope of system support planning for the ORDA system. It includes overall descriptions of the maintenance, training, and logistics support concepts for the ORDA system, and references to the ORDA Documentation Plan and Integrated Logistics Support Plan.

System support planning should ensure that ORDA support organizations are ready to provide real-time support to the ORDA system when the contractor deploys the first system. Upon deployment of the ORDA system, the Government will be responsible for continued support to the fielded system. In preparation and in support of this function, the ORDA contractor will lead a System Support Team to prepare technical manuals, drawings, and other technical documentation required to support on-equipment fault isolation and replacement by qualified technicians at the radar site. This team will also prepare and deliver to the Government a Logistics Support Analysis and a Parts Provisioning List. They will assemble all vendor or developed configuration management documentation following Government guidelines. The contractor will develop ORDA documentation that follows the ORDA Documentation Plan and control it through the Managed Document process. The NPI Program Office will submit all approved documentation to the ROC technical library in Norman, Oklahoma. Finally, the team will prepare Site Allocation Documents for each site describing the updated site configurations. The contractor will develop an ORDA maintenance-training program that is similar to the ORPG training program. The contractor will work with the NPI Program Leader and assist the NWS Technical Training Center in the development of a maintenance training approach. In addition, the contractor will provide technical assistance to the Warning Decision Training Branch in the development of weather operations training.

The purpose of this system support team is to ensure the ORDA support organizations are ready to provide real-time support to the ORDA system when OST deploys the first system. This planning will include, but not be limited to: ensuring adequate spares are in place; preparing training courses and materials for field personnel in advance of deployment; publishing technical documentation; and training and preparing NEXRAD Hotline, NRC, NWS Training Center (NWSTC), and Keesler Technical Training Center staff before deployment. Team members will be from (at a minimum) the ROC, NSSL, NWSTC, Warning Decision Training Branch, Keesler Technical Training Center, NRC, NLSC, and NWS Headquarters Logistics.

The current site maintenance policy for the ORDA system is the concept of removal and replacement of LRUs. Each agency is responsible for its own organizational or field maintenance, though management of maintenance collection and reporting and supply support management is the responsibility of the NWS Office of Operational Systems (OOS). In addition to field maintenance, each agency is responsible for its own maintenance data collection and its own common support equipment. OOS is responsible for tri-agency maintenance data reporting. OOS is responsible for centralized depot repair, on-site depot repair, supply support, and peculiar support equipment. In the future, the ORDA support plan is to stay with this basic maintenance concept. However, with the migration towards the use of multiple vendor COTS, it is anticipated that integrated logistics support planning will take advantage of such things as frequent upgrades of technical capability, higher equipment reliability, manufacturers' warranties, and outsourcing for selected functions. In addition, diagnostic software is available for many COTS products that will allow tailoring to specific equipment problem areas. Further, individual agencies may move in different directions to respond to specific mission requirements.

6 Glossary

This section is a glossary that lists the abbreviations, acronyms, definitions used, and other non-mandatory information referenced within this SEMP.

ACOTR	Associate Contracting Officer's Technical Representative
AETC	Air Education and Training Command
AFWA	Air Force Weather Agency
ANSI	American National Standards Institute
API	Application Programming Interface
APP	Application Portability Profile
AWIPS	Advanced Weather Interactive Processing System
CCC	Concurrent Computer Corporation
CCR	Configuration Change Request
CDR	Critical Design Review
CE	Concept Exploration
CM	Configuration Management
CO	Contracting Officer
COMMITS	Commerce Information Technology Solutions
COTR	Contracting Officer's Technical Representative
COTS	Commercial-Off-The-Shelf
CSMOA	Cost-Sharing Memorandum of Agreement
DOC	Department of Commerce
DoD	Department of Defense
DOT	Department of Transportation
ECP	Engineering Change Proposal
EMD	Engineering and Manufacturing Development
FAA	Federal Aviation Administration
FCA	Functional Configuration Audit
FSP	Full Scale Production
GUI	Graphic User Interface
HW	Hardware
HQ	Headquarters
IEEE	Institute of Electrical and Electronics Engineers

ILSP	Integrated Logistics Support Plan
ISO	International Standards Organization
ITWS	Integrated Terminal Weather System
JOR	Joint Operational Requirement
LAN	Local Area Network
LRIP	Low Rate Initial Production
LRU	Line Replaceable Unit
MD	Managed Document
MDA	Milestone Decision Authority
MOA	Memorandum of Agreement
MOC	Meteorological Operations Capability
MOU	Memorandum of Understanding
MSCF	Master System Control Function
NAS	National Aerospace Systems
NEXRAD	Next Generation Weather Radar
NDI	Non-Developmental Item
NIMS	NAS Infrastructure Management System
NIST	National Institute of Standards and Technology
NLSC	National Logistics Supply Center
NOAA	National Oceanic and Atmospheric Administration
NPI	NEXRAD Product Improvement
NRC	National Reconditioning Center
NSSL	National Severe Storms Laboratory
NTR	NEXRAD Technical Requirements
NWS	National Weather Service
NWSTC	NWS Training Center
OAR	Office of Atmospheric Research
OCWWS	Office of Climate, Water, and Weather Services
OPUP	Open Principal User Processor
OOS	Office of Operational Systems
ORPG	Open Radar Product Generation
ORDA	Open Radar Data Acquisition

OS&T	Office of Science and Technology
PCA	Physical Configuration Audit
PDR	Preliminary Design Review
PDRR	Program Definition and Risk Reduction
PE	Project Engineer
PI	Product Improvement
PICA	Primary Inventory Control Activity
PL	Project Leader
PMC	Program Management Committee
POC	Proof-of-Concept
PPD	Program and Plans Division
PP&M	Program Planning and Management
PRR	Production Readiness Review
PSE	Project Systems Engineer
PUP	Principal User Processor
QA	Quality Assurance
RDA	Radar Data Acquisition
RDASC	RDA Status and Control
ROC	Radar Operations Center
RPG	Radar Product Generation
RRDD	Radar Research and Development Division
SDD	System Design Description
SDP	Software Development Plan
SDR	System Design Review
SEC	Systems Engineering Center
SEMP	Systems Engineering Management Plan
SICA	Secondary Inventory Control Activity
SRR	System Requirements Review
SSS	System/Segment Specification
SW	Software
T&E	Test and Evaluation
TAC	Technical Advisory Committee

TAR	Tri-Agency Requirements
TBD	To be determined
TCP/IP	Transmission Control Protocol/Internet Protocol
TEMP	Test and Evaluation Master Plan
TP&M	Technical Planning and Management
TRR	Test Readiness Review
WAN	Wide Area Network
WARP	Weather and Radar Processor
WFO	Weather Forecast Office
WSR-88D	Weather Surveillance Radar - 1988 Doppler

7 Appendix: Example ORDA Work Breakdown Structure

This Appendix provides an example of the NPI Program Work Breakdown Structure (WBS), with the ORDA project expanded down to lower-level WBS elements. This is a sample only and does not constitute the official WBS that is the Project Engineer controls.

WBS	Name
1	Program Management
1.1	Program Planning
1.2	Financial Management
1.3	Program Control
1.4	Risk Assessment
2	Proof-of-Concept
3	Technical Planning and Management
3.1	Program Technical Planning
3.2	Process Established
3.3	System Engineering Management Plan
3.4	Tri-agency Security Planning
3.5	System Development Plan
3.6	ORDA Documentation Plan
3.7	Test and Evaluation Master Plan
3.8	Deployment/Retrofit Plan
3.9	Risk Management Plan
3.10	System Transition Plan
4	System Support Planning
4.1	Maintenance and Logistics Support Concept
4.2	Update NEXRAD ILSP
4.3	Update IPB
5	System Requirements and Functional Analysis

11   RDA Control (CI-05)

11.1   Requirements Definition

11.2   Design

11.3   PDR Preparation

11.4   Detailed Design

11.5   CDR Preparation

11.6   Development

12   RDA Equipment (CI-09)

12.1   Requirements Definition/Design

12.2   PDR Preparation

12.3   Detailed Design

12.4   CDR Preparation

12.5   Development

13   Signal Processor (CI-14)

13.1   Requirements Definition

13.2   Subcontractor Coordination/Support

13.3   Design

13.4   PDR Preparation

13.5   Detailed Design

13.6   CDR Preparation

13.7   Development

14   RDA Synchronizer (CI-18)

14.1   Requirements Definition/Design

14.2   Assess Synchronizer (Technical Report)

14.3   PDR Preparation

14.4   Detailed Design

14.5   CDR Preparation

14.6   Production Prototype Development

15   RDA Support Software Requirements

15.1   Requirements Definition

15.2   Design

15.3   PDR Preparation

15.4   Detailed Design

15.5   CDR Preparation

15.6   Development

16   System Prototype

16.1   POC developed software

16.2   POC developed hardware

16.3   Establish development & test environment at WO

16.4   Configure Test Bed at WO

16.5   Automated Test and Simulation Infrastructure (ATSI) Integration

16.6   ATSI Simulation

16.7   ATSI Automation

16.8   ATSI Evaluation Report

16.9   ATSI Purchase Decision by NPI

16.10   Level I "hooks" for POC validation

16.11   POC Validation

16.12   Deliver ported POC

16.13   Ported POC Design Review

16.14   Follow-on Software Prototyping Activities

18   Prepare for PDR

18.1   RSIS Product Review

18.2   Prepare PDR Briefings

19   PDR

19.1   Publish PDR Minutes

25   Prepare for CDR

25.1   RSIS Product Review

25.2   Prepare CDR Briefing

26   CDR

26.1   Publish CDR Minutes

31   Component Test Phase

31.1   Component Test Plan

31.2   Component Testing

31.3   Component Test Report

32   Integration Test Phase

32.1   Integration Test Plan

32.2   Write Integration Test Procedures

32.3   INTEGRATION TEST READINESS REVIEW

32.4   Integration Testing

32.7   Dry-run security tests

32.8   Integration Test Report

33   Limited Production Phase

33.1   Contracting

33.2   Vendor production & monitoring

33.3   First Article Verification

34   System Test Phase

34.1   System Test Plan

34.2   Write Draft System Test Procedures

34.3   SYSTEM TEST READINESS REVIEW

34.4   System Testing

34.5   Formal Certification & Accreditiation Testing

34.6   System Test Report

35   Acceptance Test Phase

35.1   Acceptance Test Plan

35.2   Write Draft Acceptance Test Procedures

35.3   ACCEPTANCE TEST READINESS REVIEW

35.4   Maintenance Demo

35.5   Acceptance Testing